

What is claimed is:

1        1.    A method comprising:  
2        dividing an input signal into a plurality of time-  
3        overlapping windows;  
4        transforming time-overlapping windows so as to create  
5        a plurality of frequency-transformed windows;  
6        processing selected ones of the frequency-transformed  
7        windows;  
8        adding processed frequency-transformed windows to form  
9        a frequency-domain resultant; and  
10       converting the frequency-domain resultant into a time-  
11       domain resultant.

1       2.    A method as defined in Claim 1, further  
2       comprising:  
3       selecting frequency-transformed windows for processing  
4       in accordance with reverberation paths, wherein  
5       each of the reverberation paths is associated  
6       with a respective delay.

1       3.    A method as defined in Claim 2, further  
2       comprising:  
3       selecting a frequency-transformed window that  
4       incorporates a time shift that is closest to the  
5       delay to the reverberation path.

1           4.    A method as defined in Claim 1, wherein  
2   processing selected ones of the frequency-transformed  
3   windows comprises applying a first filter that corresponds  
4   to a reverberation path.

1           5.    A method as defined in Claim 4, wherein the first  
2   filter effects a frequency-dependent attenuation that  
3   corresponds to a respective reverberation path.

1           6.    A method as defined in Claim 5, wherein  
2   processing selected ones of the frequency-transformed  
3   windows further comprises applying a head-related transfer  
4   function.

1           7.    A method as defined in Claim 6, wherein the head-  
2   related transfer function corresponds to a respective  
3   reverberation path.

1           8.    A method as defined in Claim 7, wherein the head-  
2   related transfer function corresponds to positional  
3   coordinates of the reverberation path.

1        9.    An apparatus comprising:  
2        an input stage to couple to a source of input signals  
3                and to divide an input signal into timewise-  
4                overlapping windows;  
5        a frequency transform module coupled to the input  
6                stage to transform each of the timewise-  
7                overlapping windows into a respective frequency-  
8                transformed window; and  
9        a processor to select frequency-transformed windows  
10                and to filter each of the selected windows in  
11                accordance with a respective filter so as to  
12                produce a filtered frequency-transformed window.

1        10.   An apparatus as defined in Claim 9, wherein the  
2        processor is adapted to select frequency-transformed  
3        windows by matching a frequency-transformed window to a  
4        source image.

1        11.   An apparatus as defined in Claim 10, wherein a  
2        source image corresponds to a reverberation path of an  
3        audio signal.

1        12.   An apparatus as defined in Claim 10, further  
2        comprising:

3       a table to store a plurality of transfer functions,  
4               each of the transfer functions corresponding to  
5               at least one source image

1       13. An apparatus as defined in Claim 12, wherein a  
2       source image corresponds to a reverberation path of an  
3       audio signal.

1       14. An apparatus as defined in Claim 13, wherein each  
2       of the transfer functions is a head-response transfer  
3       function that corresponds to a reverberation path.

1       15. An apparatus as defined in Claim 10, further  
2       comprising:  
3       a combiner coupled to the processor to receive a  
4               plurality of the frequency-transformed windows  
5               and to provide combined windows at an output; and  
6       an inverse frequency transform module coupled to an  
7               output of the combiner to transform combined  
8       windows into the time domain.

1       16. An apparatus as defined in Claim 12, wherein the  
2       processor comprises a plurality of source-image processors,  
3       wherein each source-image processor:

4       (i) is coupled to receive a frequency-transformed  
5       window that is matched to a respective source  
6       image;  
7       (ii) is coupled to the table to receive a transfer  
8       function associated with a respective source  
9       image; and  
10      (iii) is coupled to receive filter coefficients that  
11      correspond to the respective source image.

1        17. An article comprising a machine-readable storage  
2 medium containing instructions that, if executed, enable a  
3 system to:  
4        divide an input signal into a plurality of time-domain  
5            windows;  
6        transform each of the time-domain windows into the  
7            frequency domain so as to create a plurality of  
8            frequency-transformed windows;  
9        process selected ones of the frequency-transformed  
10           windows;  
11       combine the processed frequency-transformed windows to  
12           form a frequency-domain resultant; and  
13       convert the frequency-domain resultant into a time-  
14           domain resultant.

1        18. An article as defined in Claim 17, further  
2 comprising instructions that, if executed, enable the  
3 system to:  
4        select frequency-transformed windows for processing in  
5           accordance with one or more source images.

1        19. An article as defined in Claim 18, further  
2 comprising instructions that, if executed, enable the  
3 system to select frequency-transformed windows for

4 processing by matching a frequency-transformed window to a  
5 delay corresponding to a respective source image.

1       20. An article as defined in Claim 18, further  
2 comprising instruction that, if executed, enable the system  
3 to filter the frequency-transformed window in accordance  
4 with parameters that are derived from the source image.

1       21. An article as defined in Claim 20, further  
2 comprising instructions that, if executed, enable the  
3 system to filter the frequency-transformed window in  
4 accordance with a Head Response Transfer Function that  
5 corresponds to the source image.

1        22. A spatial audio rendering engine comprising:  
2        an input stage to divide an input signal into  
3        timewise-overlapping windows;  
4        a transform module to transform each of the timewise-  
5        overlapping windows into a frequency-transformed  
6        window;  
7        a plurality of source image processing kernels, each  
8        of the kernels to process a transformed window in  
9        accordance with parameters corresponding to a  
10       source image; and  
11       an inverse transform module coupled to the source  
12       image processing kernels to provide a time-domain  
13       signal derived from frequency-transformed windows  
14       processed by the processing kernels.

1        23. A spatial audio rendering engine as defined in  
2        Claim 22, wherein the source image processing kernels are  
3        constructed to process selected frequency-transformed  
4        windows in accordance with filter functions that correspond  
5        to respective ones of the source images.

1        24. A spatial audio rendering engine as defined in  
2        Claim 23, further comprising a plurality of Head Related  
3        Transfer Functions to selectably coupled to respective ones  
4        of the source image processing kernels for filtering a



5 transformed windows in a manner that simulates the response  
6 of a human ear to the respective source image provided to  
7 an audio display device.

1       25. A spatial audio rendering engine as defined in  
2 Claim 23, wherein source image processing kernels are  
3 constructed to process frequency-transformed windows that  
4 are time-delay matched to respective source images.

1       26. A spatial audio rendering engine as defined in  
2 Claim 25, further comprising:  
3       a signal combiner coupled to outputs of source image  
4       processing kernels to provide an output window  
5       representing a combination of the outputs of the  
6       source image processing kernels.

1       27. A spatial audio rendering engine as defined in  
2 Claim 26, further comprising:  
3       an inverse transform module coupled to the signal  
4       combiner to transform the output window signal to  
5       a time-domain signal.

1       28. A spatial audio rendering engine as defined in  
2 Claim 27, further comprising:

3       an interleave module coupled to the inverse transform  
4       module to provide an output signal to an audio  
5       display device.

1        29. A system comprising:  
2        a spatial audio rendering engine comprising:  
3        an input stage to couple to a source of input signals  
4                and to divide an input signal into timewise-  
5                overlapping windows;  
6        a frequency transform module coupled to the input  
7                stage to transform each of the timewise-  
8                overlapping windows into a respective frequency-  
9                transformed window; and  
10       a processor to select frequency-transformed windows  
11                and to filter each of the selected frequency-  
12                transformed windows in accordance with a  
13                respective filter so as to produce a filtered  
14                frequency-transformed window; and  
15       an audio display device.

1        30. A system as defined in Claim 29, further  
2 comprising:  
3        a buffer coupled to the frequency transform module to  
4                store respective ones of the frequency-  
5                transformed windows.